REQUEST FOR PROPOSAL

FOR

SOLAR PHOTOVOLTAIC SYSTEM

AND

POWER PURCHASE AGREEMENT

BID# 6683 RFP

TOWN OF WEST HARTFORD

INFORMATION

RFP FOR SOLAR PHOTOVOLTAIC SYSTEM
AND
POWER PURCHASE AGREEMENT
BID# 6683 RFP

FOR
King Philip Middle School

PROJECT MANAGER

CATHERINE DIVINEY
TOWN ENERGY SPECIALIST

ALL QUESTIONS TO

PURCHASING SERVICES
RICK HYMAN
BUYER

All questions must be submitted in writing and e-mailed to the Purchasing Office to Rick.hyman@westhartfordct.gov prior to the established timeline for questions per these bidding documents. Please do not call the Engineer/ Architect, Project Manager or Purchasing Office with questions.

I. GENERAL INFORMATION

A. Overview and Purpose of this Request for Proposal

The Town of West Hartford requests Proposals from qualified solar providers that are capable of designing and implementing solar photovoltaic (PV) systems and have experience working with commercial clients in Connecticut and experience with Eversource's ZREC program. The Town is interested in pursuing a long-term power purchase agreement (PPAs) for a solar PV array at King Philip Middle School, 100 King Philip Drive, West Harford, CT 06117. A large ZREC of $71.46 per MWh was secured for this project in Round Year 6b of Eversource's LREC/ZREC program RFP which can be assigned to the selected developer.

B. RFP Schedule

Release RFP	Feb 19, 2019
Questions Due	March 5, 2019
Responses Due	March 12, 2019
Selection	March 13, 2019

C. Additional Information

All questions, clarifications or requests for additional information in connection with this RFP should be emailed by close of business on Tuesday, March 5, 2019 to:

Rick Hyman, Buyer at Rick.hyman@westhartfordct.gov

Optional site visit will be Wednesday, February 27th at 2:30 PM. Meet at school's main entrance.

Responses to questions or requests for additional information will be posted on the Town of West Hartford's procurement web site: www.westhartfordct.gov/bids

Please note that this summer an electrical switch gear project will be taking place at King Philip School as well.

Proposers are responsible for checking the Town's procurement web site for all addenda distributed in response to questions and requests for additional information. Under no circumstances may any Respondent contact any employee or representative of the Town of West Hartford prior to the RFP submission deadline other than as provided in this section. Any violation of this condition may result in Respondent being considered non-compliant and ineligible for award.

D. RFP Response: See proposal submission section for further details.

Written responses will be accepted at the Department of Financial Services until ***3:00 pm on Tuesday, March 12, 2019***. An original reply to this RFP plus one (1) copy and one (1) electronic USB copies of the Proposer's information must be delivered to the following:

Peter Privitera, Director of Financial Services
Town of West Hartford

Department of Financial Services
50 South Main Street, Room 223
West Hartford, CT 06107

All RFP packages should be clearly marked and sealed with the Proposer's name and the words "RFP FOR SOLAR PHOTOVOLTAIC SYSTEM and POWER PURCHASE AGREEMENT BID # 6683RFP".

E. RFP Cost

Proposers are responsible for all costs incurred in the development and submission of their information packages. The Town assumes no contractual obligation as a result of the issuance of this RFP, the preparation or submission of information by a Proposer.

F. Prime Respondent Responsibility & Third Party Relationships

The Proposer should clarify its relationships with parties supplying portions of the RFP solution and specify the portions that each party is providing.

G. Instructions to Proposers

1. At the date of opening, it will be presumed that each Proposer has made a thorough examination of all information relative to the services to be performed under this contract; is satisfied as to the actual conditions and requirements of the services; and has read and become familiar with the RFP documents.
2. The Town reserves the right to reject proposal for any reason the Town deems advisable and to award a contract to any of the Proposers of service at the sole discretion of the Town. Any item required in this request for Proposals that is not included in a respondent's Proposals shall be specifically noted. If there are no specifically noted exclusions in a Proposals it will be assumed that the Proposer accepts and understands all of the requirements of this RFP.
3. Questions/Inquiries: Any questions or clarifications about this RFP should be emailed to Rick Hyman, Buyer, Town of West Hartford, at Rick.hyman@westhartfordct.gov.
4. All RFP responses will be considered confidential information and will not be available for public viewing until a contract award is made.
5. Any proposals must be valid for a period of 120 days from the due date.
6. Vendors who are furnished a copy of this RFP are requested to submit a receipt acknowledgement as soon as possible indicating their intention to participate in the RFP process to ensure timely receipt of potential corrections, cancellation and addenda. Acknowledgements shall be emailed to Rick Hyman, Buyer, Town of West Hartford, at Rick.hyman@westhartfordct.gov.
7. Proposers shall provide insurance coverage per the attached **Indemnification and Insurance Exhibit**.

H. Taxes

The Town is a qualified tax-exempt institution and as such is not liable for any federal, state, or local excise, sales, use, property or other taxes that Proposer may incur as a result of this agreement.

I. Indemnification and Insurance

The Contractor and others acting on behalf of the Contractor shall comply with the indemnification and insurance requirements described in the **Indemnification and Insurance Exhibit,** attached hereto and incorporated by reference into the final Contract. Failure to comply may be held a willful violation and basis for immediate termination of the Contract.

J. Compliance with Laws

Proposer shall operate and maintain all properties and perform all of the services required in the RFP in full compliance with all appropriate federal, state and local laws and regulations.

K. Non-Discrimination

The Proposer in performing under this agreement shall not discriminate against any workers, employee or applicant or any member of the public because of race, creed, color, religion, age, sex, marital status, national origin, mental retardation or physical disability, including but not limited to blindness, unless it is shown by Proposer that such disability prevents performance of the work involved, in any manner prohibited by the laws of the United States or the State of Connecticut, nor otherwise commit an unfair employment practice. Proposer will take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, religion, age, sex, marital status, national origin mental retardation or physical disability, including but not limited to blindness, unless it is shown by Proposer that such disability prevents performance of the work involved, in any manner prohibited by the laws of the United States or the State of Connecticut, nor otherwise commit an unfair employment practice. Proposer agrees that this non-discrimination clause will be incorporated in all contracts entered into by it with suppliers of services or materials, contractors and sub-contractors and all labor organizations furnishing skilled, unskilled and craft unions skilled labor or whom may perform any such labor or services in connection with this agreement.

L. Contract for Services

The Town and Proposer expressly agree that this is an agreement for the provision of the specific services herein described; that Proposer is to perform those services for the term set forth herein and pursuant to the provisions of this agreement; that the Proposer(s) are independent contractors, not employees of the Town, for these purposes and as such neither they nor their employees are entitled to any Town employment benefits, including without limitation, life and health insurance, vacation and sick leave, pension rights or workers compensation.

M Public Information & Ownership of Documents

All proposals submitted and information included therein or attached thereto shall become public records upon their delivery to the Town. All documents created by the Proposer during the completion of their contract requirements shall become the property of the Town, including any data bases and information systems that are created.

N. Examination of Documents

Proposers shall thoroughly examine and be familiar with these RFP documents. The failure or omission of any Proposer to examine these documents shall in no way relieve any Proposer of obligations with respect to this Request for Proposals. The submission of a Proposals shall be taken as prima facie evidence of compliance with this paragraph. The response and the Request for Proposals shall become part of any agreement by reference.

O. Selection Process and Evaluation Criteria

The responses to this RFP will be evaluated using the following criteria:

1. Cost
2. Experience working with similar municipal customers and experience securing ZRECs and implementing successful solar photovoltaic (PV) projects in Connecticut.

The Proposals will be evaluated by a Selection Committee to determine, all factors considered, the most qualified and capable firm to provide services to the Town to recommend to the Town's Purchasing Agent for contract award. The Selection Committee reserves the right to interview any or all of the Proposers prior to making their recommendation. The awarded contractor shall be mindful that Projects must be awarded a ZREC in order to move forward to installation.

II. SCOPE OF SERVICES

A. General

The Town of West Hartford requests Proposals from qualified solar providers that are capable of designing and implementing solar photovoltaic (PV) systems and have experience working with commercial clients in Connecticut and experience with Eversource's ZREC program. The Town is interested in pursuing a long-term power purchase agreement (PPAs) for a solar PV array at King Philip Middle School.

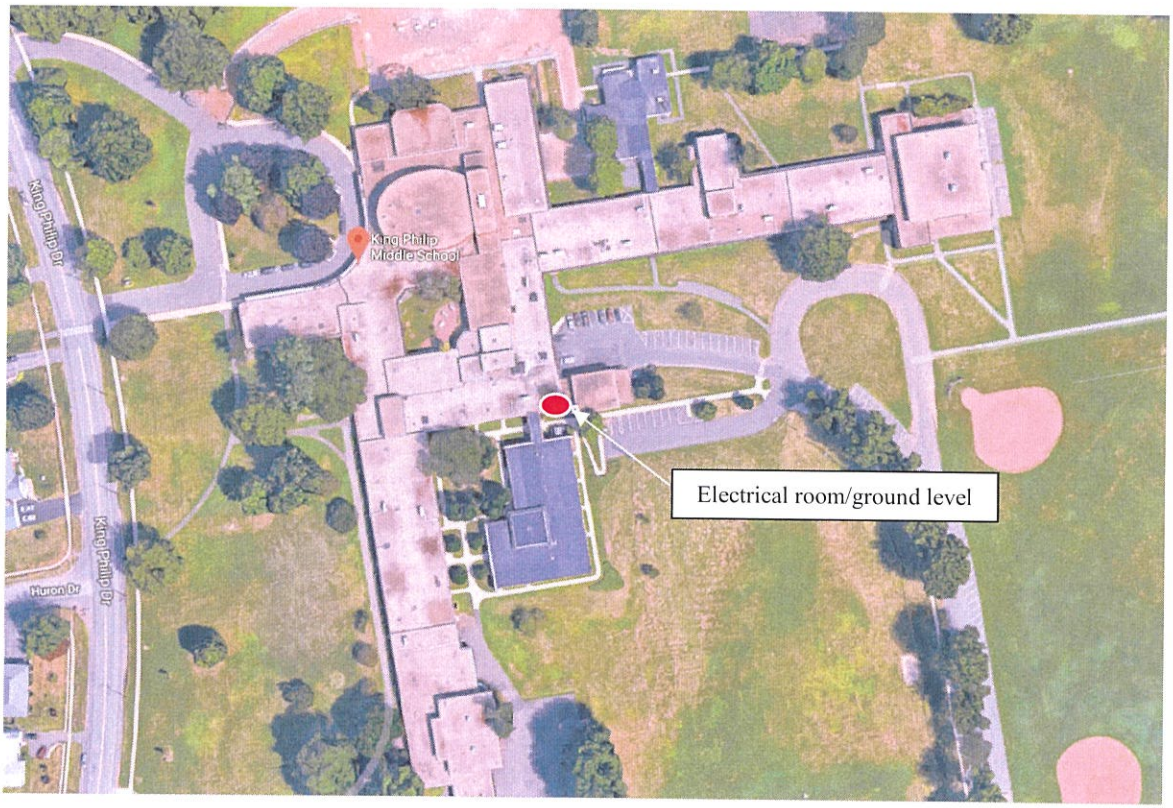
A large ZREC of $71.46 per MWh for this project was secured with a Delivery Term Start Date (DTSD) of April 1, 2019. Per Eversource's Standard Contract for the Purchase and Sale of Connecticut Class I Renewable Energy Credits, generation must begin within 12 months of the DTSD.

The Town was working with a developer on this project, but their fully-ballasted system design was not compatible with the new roof installed at King Philip Middle School in three phases (2016-2018).

Please note that this summer an electrical switch gear project will be taking place at King Philip School as well.

B. Site

King Philip Middle School is primarily a single-story building located at 100 King Philip Drive West Hartford, CT 06117.



The entire school has been re-roofed. **Roofing plans for King Philip MS are available on the Town's website.** Roof is cement deck and EDPM. Approximate square feet is 150,000. The Town cannot relocate the walkways on the roof. The Town is not opposed to a partially mechanically-fastened or mechanically-fastened system as long as it complies with roof warranties and other requirements below.

Roof Phase 1 RFP 6447F 79,639 SF
https://www.westhartfordct.gov/gov/departments/purchasing/bid_results/2015.asp

Roof Phase II RFP 6496F 42,791 SF
https://www.westhartfordct.gov/gov/departments/purchasing/bid_results/2016.asp

Roof Phase III RFP 6637F 29,119 SF
https://www.westhartfordct.gov/gov/departments/purchasing/bid_results/2018.asp

Utility bills and electric usage history are provided in an Exhibit to this RFP. Beginning in December 2019, the Town electricity supply rate will change to 7.929 all-in fixed. The Town is about to implement a full-building LED T8 lighting project is the building (Summer 2019), and expects annual kWh to decrease by 200,000 kWh annually.

C. Requirements

The following requirements are anticipated for entering into a 3rd party Power Purchase Agreement (PPA). The Town reserves the right to modify these requirements or add others prior to the actual execution of a PPA.

1. The project shall be designed, owned, and maintained by the 3rd party.
2. The solar array shall be net metered and comply with all applicable (state, local, utility) laws, codes, regulations, tariffs, etc.
3. The Town prefers inverters to be located inside the building.
4. The 3rd party is responsible ensuring that any structure upon which the array may be placed are suitable for any and all loads associated with system.
5. The 3rd party is responsible for ensuring that the solar array and any associated components do not impact any existing roof warranties.
6. The 3rd party is responsible for providing all information necessary for project approvals from the Town's insurance carrier, FM Global. This may involve responding to specific questions, providing stamped drawings, and/or third-party review of project-specific details. The Town's preference is to comply with all FM Global recommendations. (See **FMDS0115: FM Global Property Loss Prevention Data Sheets 1-15.**)
7. The 3rd party is responsible for preparing all interconnection documentation and paying all fees as required by local distribution utility.
8. The 3rd party is responsible for all fees associated with the design, development, and construction of the projects (including but not limited to permits, reviews, or other permissions necessary for the projects.)
9. Installation may not proceed until all necessary approvals have been received (e.g., proof of insurance, interconnection agreements, building permits, roof manufacturer and FM Global sign-offs).
10. The 3rd party is responsible for all reporting associated with the ZREC program.

III. RFP RESPONSES

A. Submission Requirements

Please be clear and concise in your responses. To achieve a uniform review process and obtain the maximum degree of comparability, it is required that the submission be organized in the following manner.

1. Title Page & Company Information: (MAX 1 page) Please indicate 6683RFP#, the

name of your organization, address, telephone number, name of contact person and date. Please provide a BRIEF description of your company.

2. Comparable Projects (Table format preferred): Please provide details on three (3) relevant, recent municipal projects in Connecticut. For each project, please list:
    a. Client;
    b. Site;
    c. Solar array size;
    d. Reference contact information for client.
3. Power Purchase Agreement: A copy of the power purchase agreement which would be used for the project(s). **PLEASE DO NOT PRINT POWER PURCHASE AGREEMENT FOR HARD-COPY RFP SUBMISSIONS. Provide electronic copy only on USB drive.**
4. Price Proposal: The system size (KW, Capacity DC) and price per kWh that you propose for the project. Please use the following assumptions:
    - A ZREC price of $71.46
    - A 0% escalator for price per kWh. (i.e., the Town wishes to pay the same fixed rate per kWh for the full term of the PPA.)

The Town reserves the right to investigate the Proposals of all Proposers under consideration and to confirm any part of the information furnished by a Proposer, or to require other evidence of managerial, financial or technical capabilities that are considered necessary for the successful performance of the Projects. This could include requesting pricing information on comparable municipal projects.

The Town reserves the right to cancel the request for proposals (RFP), modify any requirements contained within the RFP and request a revised submission from all Proposers, and to establish other evaluation criteria determined to be in the best interest of the Town.

King Philip Electric (kWh) Use History

Site: 52031 (KING PHILIP MIDDLE SCHOOL)

EVERSOURCE CT ELECTRIC 51311212088

Electric	JAN 2016	FEB 2016	MAR 2016	APR 2016	MAY 2016	JUN 2016	JUL 2016	AUG 2016	SEP 2016	OCT 2016	NOV 2016	DEC 2016	Total
SERVICE													
DATES	12/17-01/19	01/20-02/17	02/18-03/17	03/18-04/19	04/20-05/17	05/18-06/17	06/18-07/19	07/20-08/18	08/19-09/19	09/20-10/18	10/19-11/16	11/17-12/16	
TOTAL $	$ 7,619.87	$ 7,776.82	$ 7,687.32	$ 7,608.65	$ 7,817.83	$ 9,167.67	$ 11,274.99	$ 14,158.22	$ 18,743.51	$ 15,645.37	$ 15,117.60	$ 15,656.33	$ 138,274.18
TOTAL KVA	264	249.6	248.6	270.7	334.6	427.7	292.3	398.4	584.6	436.8	379.7	280.8	584.6
TOTAL KW	290.4	268.3	262.1	248.6	297.1	391.7	253.4	357.1	546.7	402.2	351.8	297.6	546.7
GENERATION KWH	0.00	0.00	0.00	0.00	0.00	0.00	52,800.00	62,400.00	91,200.00	72,480.00	76,800.00	87,840.00	443,520.00
TOTAL KWH	**90,720.00**	**88,320.00**	**83,040.00**	**78,720.00**	**69,600.00**	**79,200.00**	**52,800.00**	**62,400.00**	**91,200.00**	**72,480.00**	**76,800.00**	**87,840.00**	**933,120.00**
TOTAL $ / KWH	0.08399	0.08805	0.09257	0.09665	0.11233	0.11575	0.21354	0.22689	0.20552	0.21586	0.19684	0.17824	0.14818

EVERSOURCE CT ELECTRIC 51311212088

Electric	JAN 2017	FEB 2017	MAR 2017	APR 2017	MAY 2017	JUN 2017	JUL 2017	AUG 2017	SEP 2017	OCT 2017	NOV 2017	DEC 2017	Total
SERVICE													
DATES	12/17-01/18	01/19-02/15	02/16-03/16	03/17-04/18	04/19-05/16	05/17-06/16	06/17-07/18	07/19-08/17	08/18-09/18	09/19-10/17	10/18-11/15	11/16-12/15	
TOTAL $	$ 16,086.37	$ 15,051.24	$ 14,639.55	$ 15,566.10	$ 12,768.23	$ 15,999.55	$ 14,476.85	$ 13,438.38	$ 14,353.23	$ 14,719.48	$ 12,328.03	$ 13,655.18	$ 173,082.19
TOTAL KVA	301.4	293.8	282.7	297.6	282.2	509.3	423.4	329.3	393.1	438.7	261.6	279.4	509.3
TOTAL KW	284.6	276	264.5	277.4	263.5	465.1	460.3	307.2	360	455.5	243.8	262.6	465.1
GENERATION KWH	92,640.00	84,000.00	81,120.00	89,280.00	63,840.00	79,680.00	69,120.00	63,360.00	72,480.00	71,520.00	65,280.00	81,120.00	913,440.00
TOTAL KWH	**92,640.00**	**84,000.00**	**81,120.00**	**89,280.00**	**63,840.00**	**79,680.00**	**69,120.00**	**63,360.00**	**72,480.00**	**71,520.00**	**65,280.00**	**81,120.00**	**913,440.00**
TOTAL $ / KWH	0.17364	0.17918	0.18047	0.17435	0.2	0.2008	0.20945	0.2121	0.19803	0.20581	0.18885	0.16833	0.18948

EVERSOURCE CT ELECTRIC 51311212088

Electric	JAN 2018	FEB 2018	MAR 2018	APR 2018	MAY 2018	JUN 2018	JUL 2018	AUG 2018	SEP 2018	OCT 2018	NOV 2018	DEC 2018	Total
SERVICE													
DATES	12/16-01/17	01/18-02/15	02/16-03/19*	03/20-04/19	04/20-05/17	05/18-06/18	06/19-07/18	07/19-08/17	08/18-09/18	09/19-10/17	10/18-11/15	11/16-12/17	
TOTAL $	$ 8,218.02	$ 7,669.87	$ 7,314.34	$ 7,264.96	$ 8,551.94	$ 8,202.60	$ 8,571.64	$ 5,632.53	$ 10,654.38	$ 8,729.55	$ 8,096.89	$ 8,685.00	$ 97,591.72
TOTAL KVA	306.2	253.4	267.8	273.1	380.2	361.4	465.1	121.4	516	355.2	260.6	285.6	516
TOTAL KW	289.9	284.6	250.1	255.4	349.9	329.3	428.2	94.1	558.2	419.5	277.9	268.8	558.2
GENERATION KWH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL KWH	**101,280.00**	**85,920.00**	**79,200.00**	**73,440.00**	**66,720.00**	**71,520.00**	**46,560.00**	**43,680.00**	**83,040.00**	**70,080.00**	**81,120.00**	**99,840.00**	**902,400.00**
TOTAL $ / KWH	0.08114	0.08927	0.09235	0.09892	0.12818	0.11469	0.18410	0.12895	0.12830	0.12457	0.09981	0.08699	0.10815

EVERSOURCE CT ELECTRIC 51311212088

Electric	JAN 2019	FEB 2019	MAR 2019	APR 2019	MAY 2019	JUN 2019	JUL 2019	AUG 2019	SEP 2019	OCT 2019	NOV 2019	DEC 2019	Total
SERVICE													
DATES	12/18-01/17												
TOTAL $	$ 8,445.04	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,445.04
TOTAL KVA	306.7	0	0	0	0	0	0	0	0	0	0	0	306.7
TOTAL KW	291.4	0	0	0	0	0	0	0	0	0	0	0	291.4
GENERATION KWH	0.00	0	0	0	0	0	0	0	0	0	0	0	0.00
TOTAL KWH	**93,120.00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**93,120.00**
TOTAL $ / KWH	0.09069	0	0	0	0	0	0	0	0	0	0	0	0.09069

0000780

EVERSOURCE

TOWN OF WEST HARTFORD BOARD OF

Due Date	Total Amount Due
Mar 18, 2019	$12,752.80

Statement date: Jan 17, 2019
Customer name key: WEST

Account number: 51311212088

Contact Information
Emergency: 1-800-286-2000 (anytime)
Web Site: www.eversource.com
Email: BusinessCenterCT@eversource.com
Pay by Phone 1-888-783-6618

Business customers:
Customer Service: 1-888-783-6617
Your electric supplier is
CONSTELLATION NEWENERGY C&I
1221 LAMAR ST SUITE 750
STE
HOUSTON TX 77010-3038
1-844-636-3749

Electric Account Summary

Amount due on Dec 17	$8,787.85
Payment Dec 19	-$2,186.62
Adjustment Jan 14	-$2,293.47
Balance Forward	$4,307.76
New Charges/Credits	
Electricity Supply Services	$0.00
Delivery Services	$8,445.04
Total new charges	$8,445.04
Total amount due	**$12,752.80**

Payment due upon receipt unless other arrangements have been made.

** Please remit the past due amount of $4,307.76. This amount is due immediately in order to avoid a possible service disconnection. Please disregard if you have made a payment or confirmed a payment arrangement. (e.g., Matching Payment Program).

Thank you for your payments during 2018. We look forward to serving you in 2019.

Detail for Service at: KING PHILIP JR H S

100 KING PHILIP DR , WEST HARTFORD CT 06117-1316
Service reference: 617051009 Billing cycle: 12

Please allow up to 5 business days for your payment to post.

Remit Payment To: Eversource, P.O.Box 56002, Boston, MA 02205-6002

(continued on next page)

Make your check payable to Eversource. Please consider adding $1 for Operation Fuel. To add more visit www.eversource.com

EVERSOURCE

Account Number	Statement date	Total amount due	Amount Enclosed
51311212088	Jan 17, 2019	$12,752.80	

Payment due upon receipt unless other arrangements have been made.

000474 000001370

TOWN OF WEST HARTFORD BOARD OF
PO BOX 1028
MANDAN ND 58554-7028

2

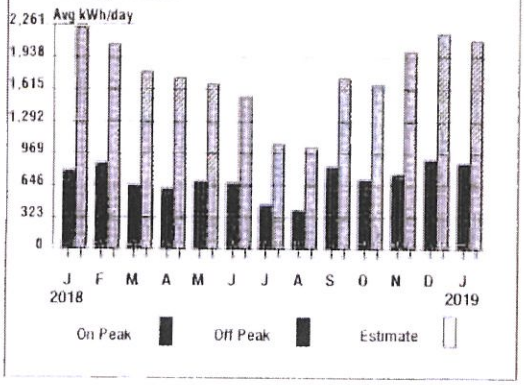
Eversource
PO Box 56002
Boston, MA 02205-6002

513112120883 2 0012752805 0008445045

Compare your electricity usage

Average usage in Jan 2018 (27 F)	3069 kWh
Average usage in Jan 2019 (31 F)	3004 kWh

Energy Profile



Your meter reading for meter # 891055332

For billing period: Dec 17 - Jan 17 (31 days)

Next read date on or about: Feb 15, 2019

Actual reading on Jan 17, 2019 on peak	2237
Actual reading on Dec 17, 2018 on peak	- 2180
Difference	= 57
Meter constant	x 480
Billed usage	= 27,360

Max On-Peak Demand: 261.60 kW
Max On-Peak Demand: 278.40 kVA

Actual reading on Jan 17, 2019 off peak	5457
Actual reading on Dec 17, 2018 off peak	- 5320
Difference	= 137
Meter constant	x 480
Billed usage	= 65,760

Max Off-Peak Demand: 291.40 kW
Max Off-Peak Demand: 306.70 kVA

Please allow up to 5 business days for your payment to post.

Remit Payment To: Eversource, P.O.Box 56002, Boston, MA 02205-6002

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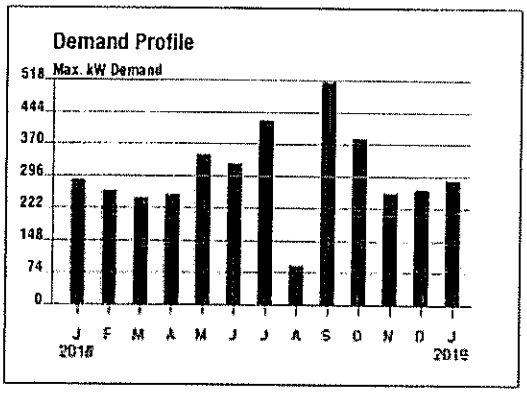

Allocated use for 14 days (Dec 17 to Dec 31)

Delivery Services Detail	DISTRIBUTION RATE: 056					
Prod/Trans Dmd Chrg	278.40KVA	x	$8.100000	x	0.4516	$1,018.38
Distr Cust Srvc Chrg	$350.000000	x	0.4516			$158.06
Electric Sys Improvements***	558.20KVA	x	$0.110000	x	0.4516	$27.73
Distribution Dmd Chrg	558.20KVA	x	$7.450000	x	0.4516	$1,878.02
Revenue Adj Mech On-Pk	12355.70KWH	x	$0.002010			$24.83
Revenue Adj Mech Off-Pk	29697.20KWH	x	$0.002010			$59.69
Prod/Trans CTA Dmd Chrg	278.40KVA	x	$0.060000	x	0.4516	$7.54
FMCC Delivery Chrg On-Pk	12355.70KWH	x	$0.019320			$238.71
FMCC Delivery Chrg Off-Pk	29697.20KWH	x	$0.004270			$126.81
Combined PBC - On-Pk*	12355.70KWH	x	$0.007180			$88.71
Combined PBC - Off-Pk*	29697.20KWH	x	$0.007180			$213.23
Subtotal						$3,841.71

Allocated use for 17 days (Dec 31 to Jan 17)

Delivery Services Detail	DISTRIBUTION RATE: 056					
Prod/Trans Dmd Chrg	278.40KVA	x	$8.170000	x	0.5484	$1,247.35
Distr Cust Srvc Chrg	$350.000000	x	0.5484			$191.94
Electric Sys Improvements***	558.20KVA	x	$0.160000	x	0.5484	$48.98
Distribution Dmd Chrg	558.20KVA	x	$7.450000	x	0.5484	$2,280.57
Revenue Adj Mech On-Pk	15004.30KWH	x	$0.001810			$27.16
Revenue Adj Mech Off-Pk	36062.80KWH	x	$0.001810			$65.27
Prod/Trans CTA Dmd Chrg	278.40KVA	x	-$0.230000	x	0.5484	- $35.12
FMCC Delivery Chrg On-Pk	15004.30KWH	x	$0.017680			$265.28
FMCC Delivery Chrg Off-Pk	36062.80KWH	x	$0.003900			$140.64
Combined PBC - On-Pk*	15004.30KWH	x	$0.007270			$109.08
Combined PBC - Off-Pk*	36062.80KWH	x	$0.007270			$262.18
Subtotal						$4,603.33

Service Account Messages

Distribution Demand based on ratchet
Because the billing period spans a change in the rates, your usage has been calculated partly on the old rate and partly on the new rate.

Please allow up to 5 business days for your payment to post.

Remit Payment To: Eversource, P.O.Box 56002, Boston, MA 02205-6002

(continued on next page)

Explanation of your charges

*The Combined Public Benefits Charge represents a combination of three charges formerly known as: Conservation and Load Mgmt Charge, Renewable Energy Investment Charge, and Systems Benefits Charge. This charge also includes the Conservation Adjustment Mechanism approved by the Public Utilities Regulatory Authority in Docket No. 13-11-14.

**Effective January 1, 2007, the Generation Services Charge (GSC) and the Bypassable Federally Mandated Congestion Charge (BFMCC) have been combined into the "GSC Charge" listed in the Supplier Services section of your bill. The GSC reflects all of the cost of procuring energy from Eversource wholesale suppliers. The BFMCC portion of this line item is -$0.0001/kWh. If you multiply this BFMCC rate by the number of kWhs on your bill, you can calculate the dollar amount associated with the BFMCC.

***Electric System Improvements: Recovers company investments that protect, strengthen or modernize the electric grid.

Account messages

Max KW vs Max KVA Ratio = 261.6 / 278.4 = .940
Power Factor at Max KVA = 261.6 / 278.4 = .940
This meter is tax exempt

Please allow up to 5 business days for your payment to post.

Remit Payment To: Eversource, P.O.Box 56002, Boston, MA 02205-6002

(continued on next page)

Customer Billing Information

Questions and complaints

If you have a question or complaint about your bill or any payment arrangement, call the number listed on the front of the bill. A complete explanation of your rights is available upon written request to the company or by calling customer service at the phone number listed in the upper left corner of the bill.

Termination of service and customer rights

You have the right to dispute a termination notice. You may also have service continued between November 1st and May 1st if you qualify for hardship status or have a serious illness or life-threatening condition.

Third-party notice

You can ask us at any time to notify a third party if your service is subject to being shut off. For additional information, you should call the number listed on the front of the bill.

Electric suppliers

Information about licensed electric suppliers, including rates and charges, contract terms and conditions, energy sources and emission rates, is available from the Public Utilities Regulatory Authority (PURA), 10 Franklin Square, New Britain, Connecticut, 06051, by visiting www.EnergizeCT.com/suppliers

Check processing

By sending your check, you authorize Eversource to use the check information to create an electronic funds transfer. The electronic transfer, for the original check amount, will be processed on the day your check is received. The check will be destroyed and an image of your check will be stored for 2 years. If the electronic transfer cannot be completed, a demand draft of your check can be created and used in place of the original.

Security Deposit

PURA Regulation 16-11-105 allows the Company to collect a security deposit from business customers with either no credit or a negative credit history with the Company. Business customers with a timely bill payment history will not be assessed a security deposit.

PURA Regulation 16-262j-1 allows the Company to collect a security deposit from a residential customer who has either no credit or a negative credit history with the Company. Customers who can verify that they lack the financial ability to pay a security deposit will not be required to pay a security deposit.

Security deposits, along with accrued interest, will be refunded to the customer after 12 consecutive months of good payment history.

Information and questions

For information or questions regarding your account, please contact Eversource at 860-947-2000 or 1-800-286-2000. For other consumer questions and unresolved complaints, you may call PURA Consumer Services toll free at 1-800-382-4586.

Información en la Factura para el Consumidor

Preguntas y quejas

Si usted tiene alguna pregunta o queja sobre su factura o sobre algun arreglo de pago, llame al numero listado al frente de esta factura. Una explicación detallada de sus derechos como consumidor está disponsible si lo pide por escrito a la compañía o si llama al centro de servicios al consumidor al número listado arriba, a la izquierda en su factura

Terminación de servicio y sus derechos como consumidor

Usted tiene el derecho de refutar la carta de terminación. También podrá continuar el servicio entre el 1 de Noviembre y el 1 de Mayo, si usted califica como consumidor con dificultad económica documentada o tiene alguna enfermedad seria, o una situación de vida o muerte existente en su hogar

Notificación a una tercera persona

Usted puede solicitar en cualquier momento que nos comuniquemos con una tercera persona si su servicio esta en riesgo de ser desconectado. Para más informacion, llame al numero listado en su factura

Proveedores de energia eléctrica

Información acerca de proveedores de energia eléctrica licenciados, incluyendo clases de tarifas y cargos, términos y condiciones de contratos, fuentes de energia y tarifas de emisión, estan disponibls a los consumidores a través de la Autoridad Reguladora de Servicios Públicos (PURA), 10 Franklin Square, New Britain, Connecticut, 06051, o visitando www.EnergizeCT.com/suppliers

Procesamiento de cheques

Al enviar su cheque, usted autoriza a Eversource a usar la información de su cheque para crear transferencias de fondos electrónicamente. La transferencia electrónica por la cantidad original del cheque sera procesada el dia que su cheque es recibido. El cheque sera destruido y una copia electrónica será guardada por 2 años. Si la transferencia electrónica no puede ser completada podemos exigir un retiro de fondos y este puede ser usado en lugar del original

Déposito de Seguridad

Segun la Regulacion 16-11-105 de "PURA," a la Compañia se le permite colectar un depósito de seguridad de aquellos clientes comerciales o industriales que no tengan crédito, o que tengan crédito negativo con la Compañía. A los clientes comerciales o industriales que tengan un historial de crédito con pagos hechos a tiempo, no se les cobrara un deposito de seguridad

La Regulacion de PURA 16-262j-1 permite que la compañia colecte un depósito de seguridad de aquellos clientes residenciales que no tengan credito, o que tengan crédito negativo con la compañia. Los clientes que puedan verificar que no tienen la habilidad financiera para pagar su depósito de seguridad no tendrán que pagarlo. Los depósitos de seguridad, junto con el interés que se haya acumulado, les serán devueltos a los clientes después de que hayan cumplido 12 meses consecutivos de buen historial con sus pagos

Para información o preguntas

Para informacion o preguntas relacionadas con su cuenta por favor llame a Eversource al 860-947-2000, o 1-800-286-2000

Para mas informacion y para asistencia sobre disputas no resueltas, llame a PURA al numero 1-800-382-4586

ROOF MOUNTED SOLAR PHOTOVOLTAIC PANELS

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1.0 SCOPE

This data sheet provides property loss prevention guidance related to fire and natural hazards for the design, installation, and maintenance of all roof mounted photovoltaic (PV) solar panels used to generate electrical power. This document does not address solar towers, roof-mounted solar-powered water heaters, or ground-mounted solar farms. For guidance on ground-mounted solar farms, see Data Sheet 7-106, *Ground-Mounted Photovoltaic Solar Power.*

1.1 Changes

October 2014. Interim revision. Added additional diagram (Fig. 12B, *One-line example diagram to a PV system with ground faults*).

2.0 RECOMMENDATIONS

Use FM Approved equipment, materials, and services whenever they are applicable and available. For a list of products and services that are FM Approved, see the *Approval Guide*, an online resource of FM Approvals.

2.1 Construction and Location

2.1.1 Wind

2.1.1.1 Design all roof-mounted, rigid PV solar panels and their securement for wind speeds and surface roughness exposures in accordance with DS 1-28, *Wind Design*. An importance factor of 1.0 may be used if acceptable by local codes. Use Exposure C in non-coastal areas, unless all conditions for Exposure B are met. Use the topographic factor (K_{ZT}) as determined using ASCE 7, except for locations with relatively flat terrain (<10° ground slope), where K_{ZT} can be assumed to be 1.0. Use a minimum safety factor (SF) of 2.0 for wind loads on panel anchors. A minimum safety factor of 1.6 may be used for other wind loads. Use rigid PV solar panels that are FM Approved in accordance with Approval Standard 4478, where available.

2.1.1.2 Design wind pressure resistance for ballasted or anchored roof-mounted PV panels using one of the following options:

A. Provide wind resistance based on prescriptive calculation methods provided in SEAOC PV2 (see Section 4.2).

B.Provide wind resistance based on boundary layer wind tunnel (BLWT) data per ASCE 49 (or equivalent international standard). SEAOC PV2 lists organizations that are qualified to conduct BLWT tests.

Have the design for each specific installation reviewed and accepted by a third party that is qualified in the interpretation and application of BLWT data. Computational fluid dynamics (CFD) modeling should not be used as the primary substantiation for the design of wind resistance. It should only be used to interpolate (not extrapolate) BLWT test data. The design should consider, among other things, whether the arrays are closed (wind deflectors, see Figure 1) or open.

2.1.1.3 Install rigid PV solar panels over metal standing seam roofs (SSR) using external seam clamps that are FM Approved and properly fit the specific standing seam rib type at each seam. Torque clamps and intermittently inspect for continued tightness in accordance with the manufacturer's instructions.

Installing clamps only at every other seam is not acceptable and does not follow the wind load path as designed by the SSR manufacturer. For new buildings, use SSRs that are FM Approved in accordance with Approval Standard 4471, as specified in Roof*Nav*, and installed in accordance with Data Sheet 1-31, *Metal Roof Systems*. When installed over existing SSRs, the adequacy of the roof should first be determined to be adequate. Secure clamps as close as practical to the internal seam clips securing the standing seam roof panels to purlins. A less desirable alternative for rigid PV solar panels is to fasten them through the deck and directly into the purlins.However, this option is more prone to leakage and suitable sealing of the deck must be provided.

Ensure design wind loads are in accordance with the recommendations in Section 2.1.1.1 and 2.1.1.2.

Fig. 1. Wind deflectors provided on the high sides of panels in each row (closed array)

2.1.1.4 Install ballasted rigid PV roof-mounted solar panels roofs with a maximum roof slope of 1/2 in. per ft (2.4°). A higher slope is not recommended for ballasted PV panels as it will decrease frictional resistance to wind forces and increase sliding forces from gravity loads, weakening wind resistance. Use a combined weight of solar panels, associated hardware, and additional concrete paver blocks as needed to meet wind loads per Sections 2.1.1.1 and 2.1.1.2.

Install materials on the underside of the ballasted solar panel pedestals and paver trays, which in combination with the type of roof cover below will provide the minimum coefficient of static friction (μ, the lesser of the wet or dry value) needed for the array size and ballast weight proposed. Conduct tests for μ in accordance with ASTM D1894 (or equivalent standard outside the United States). If separator sheets are proposed between the pedestals and the roof covers, friction tests should reflect their presence.

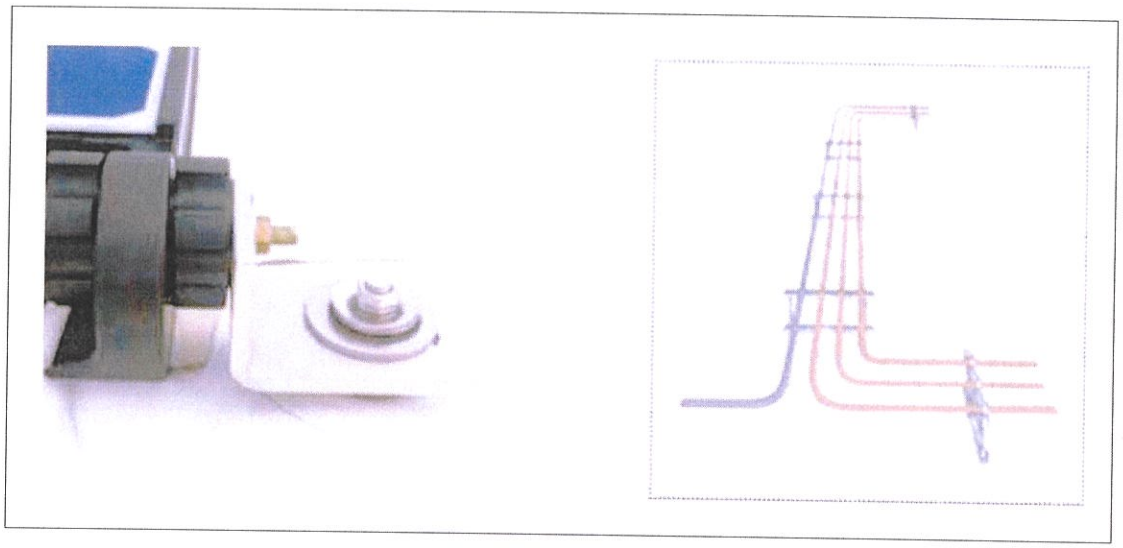
2.1.1.5 Install ballasted, rigid PV roof-mounted solar panels over fully adhered roof covers. Mechanically fasten solar panels when the roof cover is mechanically fastened.

2.1.1.6 Use concrete paver blocks for ballasted PV panels that meet specifications in ASTM C1491 and are satisfactorily tested in accordance with ASTM C1262 for exposure to freeze-thaw cycles. (Use comparable standards outside the United States.)

2.1.1.7 Keep the roof surface free from all forms of roof aggregate, including pea gravel or larger stone ballast, which could result in windborne debris damage to the PV panels. Also, if ballasted PV pedestals or paver trays are installed directly on top of roofing aggregate, it can adversely affect the arrays' resistance to sliding. Roof cover ballast that is continuous over the entire roof cover and consists of concrete paver blocks designed in accordance with DS 1-29, *Roof Deck Securement and Above-Deck Roof Components,* are acceptable if a sufficient weight of concrete paver blocks is provided above the solar panel pedestals or paver trays to provide the needed wind resistance for the solar panels.

2.1.1.8 Anchor all related equipment, such as combiner/junction boxes and conduits, to the roof deck or roof structural members (or inverters to concrete foundations) as required to provide proper anchorage against expected loads (see Figures 2A, 2B, and 9). Use mechanical anchors that can be connected to the equipment and to the roof deck or roof framing. The dead weight and resulting frictional resistance for most equipment is not sufficient to resist wind uplift and lateral wind loads.

2.1.1.9 During installation, complete all required steps for the securement of PV panels before the end of each shift. This includes the connection to previously installed panels and any needed additional ballast.



Figs. 2A and 2B. Examples of mechanical anchors used to secure equipment to the roof deck or roof framing

2.1.2. Fire Exposure and Classification

2.1.2.1 Provide noncombustible, compressible insulation (such as mineral wool) within roof expansion joints when new PV installations are to be installed on new or existing roof covers.

2.1.2.2 Install roof assemblies that are FM Approved per Approval Standard 4478 with the specific roof-mounted PV panel used when new roofs are to be installed before the installation of new roof-mounted solar panels. Use insulation or cover boards directly below the roof cover that are noncombustible. This includes gypsum cover boards and mineral wool or expanded glass insulation.

2.1.2.3 Do not use PV panel systems that contain foam plastic, such as extruded foam polystyrene, unless specifically FM Approved as part of the assembly (consider both interior or Class 1 rating and exterior fire exposure). The assembly should maintain a Class 1 or noncombustible fire rating for underside fire exposure. Do not install PV arrays within 50 ft (15 m) of maximum foreseeable loss (MFL) subdivisions (see DS 1-22, *Maximum Foreseeable Loss*).

2.1.2.4 Provide sufficient aisle spaces (4 ft, 1.2 m) between other adjacent PV arrays, other adjacent rooftop equipment or penetrations, and between PV panels and expansion or control joints on each side. Submit the proposed layout to the public fire service for review and acceptance. Minimum 4 ft (1.2 m) wide aisles at a maximum of 150 ft (46 m) in each direction is recommended and may be required by some local public fire services.

2.1.3 Gravity Loads and Roof Drainage

2.1.3.1 Install PV systems on roofs with minimum slopes of ¼ in. per ft (1°; 20 mm/m), but not greater than noted in Section 2.1.1.4. For existing roofs with less slope, evaluate for potential roof collapse (see DS 1-54, *Roof Loads for New Construction*.) and vegetation growth resulting from ponding and water accumulations. Wind exposure will increase in some areas of the roof when the slope exceeds 7°.

2.1.3.2 Design the roof for snow drifting potentially caused by the PV arrays in accordance with DS 1-54. The greater the slope of the PV panels and the height of their high end, the greater snow drifting is likely to be.

2.1.3.3 Analyze existing roofs to ensure the dead weight of the proposed PV system, including any additional recommended ballast weight, does not reduce the roof resistance to snow, rain, and other live loads below acceptable levels.

2.1.3.4 Provide proper drainage for PV panel systems that contain curbs around the perimeter of an array, or continuous beams resting directly on the roof cover and supporting panels within an array. Analyze in

accordance with DS 1-54, *Roof Loads for New Construction*. The volume of the rainfall displaced by the PV system within the curbed area may be deducted when determining the added weight of the rainfall within the curbed area.

2.1.3.5 Design the PV panels to resist design roof snow loads, including potential drifting, in accordance with DS 1-54.

2.1.4 Hail

2.1.4.1 For the following hail-prone areas (see Appendix A and DS 1-34 for definitions), use PV panels that have the shown hail ratings (established in accordance with FM Approval Standard 4478, 4476 or 4473):

- Very Severe Hail Area: Class 4 (2 in.; 50 mm diameter ice ball)
- Severe Hail Area: Class 3 (1.75 in.; 44 mm diameter ice ball) or Class 4 (2 in.; 50 mm diameter ice ball)
- Moderate Hail Area: Class 2 (1.5 in.; 38 mm diameter ice ball), Class 3 (1.75 in.; 44 mm diameter ice ball) or Class 4 (2 in.; 50 mm diameter ice ball)

2.1.5 Earthquake

2.1.5.1 Attach rigid PV solar panels to the roof deck or framing for installations located in seismic zones 50 through 500 years, as defined in DS 1-2. Use welded, bolted, or other positive fastening methods as required by Chapter 13 of ASCE 7. Do not consider frictional resistance dependent on gravity. Test PV panels in accordance with Approval Standard 4478. Otherwise, the design may be in accordance with SEAOC PV1.

2.2 Operation and Maintenance

2.2.1 Check all equipment for damage or required maintenance after severe wind or snow storms.

2.2.2 Perform PV array insulation resistance tests every three years. The resistance measured with test voltage specified should not be less than the minimum resistance per Table 1 (refer to IEC 62446).

2.2.3 Perform a thermo-graphic survey for all electrical components (e.g., inverters, wire connections, and modules) annually.

2.2.4 Visually inspect inverters on a daily basis.

2.2.5 Test inverters annually to ensure correct operation in accordance with the manufacturer's specifications.

2.2.6 Inspect wiring connections and terminations annually for corrosion and tightness, and repair or replace as needed.

2.2.7 Inspect the sealing of roof penetrations for water-tightness annually, and repair or replace as needed.

2.2.8 Adjust the inspection and testing frequencies depending on the particular type of equipment and its duty, failure history, criticality, and condition using guidance specified in DS 5-20, *Electrical Testing*. Inspection and testing frequencies noted are a general guide.

Table 1. Minimum Values of Insulation Resistance

Test Method	*Array voltage (V)*	*Test Voltage (V)*	*Minimum Insulation Resistance (MΩ)*
Test Method 1: Separate tests to array positive and array negative.	<120	250	0.5
	120-500	500	1
	>500	1000	1
Test Method 2: Array positive and negative shorted together.	<120	250	0.5
	120-500	500	1
	>500	1000	1

2.2.9 Inspect solar panel assemblies at least annually to ensure mechanical connections between panels and supports have not loosened or become corroded, and that concrete paver blocks have not deteriorated. Tighten connections and replace corroded or deteriorated materials as needed.

2.2.10 Perform maintenance inspections and testing for all the relevant equipment on the alternating current (AC) side of solar electrical system in accordance with DS 5-10, DS 5-20, and DS 5-31. This includes transformers, switchgears, circuit breakers, fuses, and cables. Follow guidelines in DS 5-20 for electrical equipment with voltages of 600 V or less, and DS 5-19 for electrical equipment with voltages higher than 600 V. See DS 5-32 for cables and bus-bars.

2.2.11 Arrange pre-fire planning with the local public fire service. Ensure they are familiar with ground access, stairs to the roof, PV array aisles, the location of combiner boxes and inverters, and all related fuses and disconnects.

2.3 Electrical

2.3.1 Install new PV electrical energy systems, including the array circuit(s), inverter(s) and controller(s) for these systems, in accordance with Article 690 of the 2014 version of NFPA 70, *National Electric Code* (or equivalent international standard).

2.3.2 Install (new installations) or retrofit (existing installations) PV systems as follows.

A. Provide one of the following:

1. Residual current DC monitoring (RCD) on +/- feeder circuits, or
2. Electronic DC current sensing relay in ground circuit in series with ground fault fuses

B. Provide interlocks to trip the DC feed to the inverter and initiate an on-site building alarm. Emergency procedures should state that a prompt response to this alarm should include an investigation of the ground fault.

The goal of the above recommendations (parts A and B) is to resolve the initial problem prior to the second ground fault. Recent losses have shown that traditional ground fault protection (GFP) using fuses per Article 690 of the NEC is not sufficiently sensitive and allows "blind spots" with an undetected initial ground fault. Given a second ground fault, this can result in enough energy to start a roof-top fire. For more information, see Figures 3 and 4 and Section 3.3.

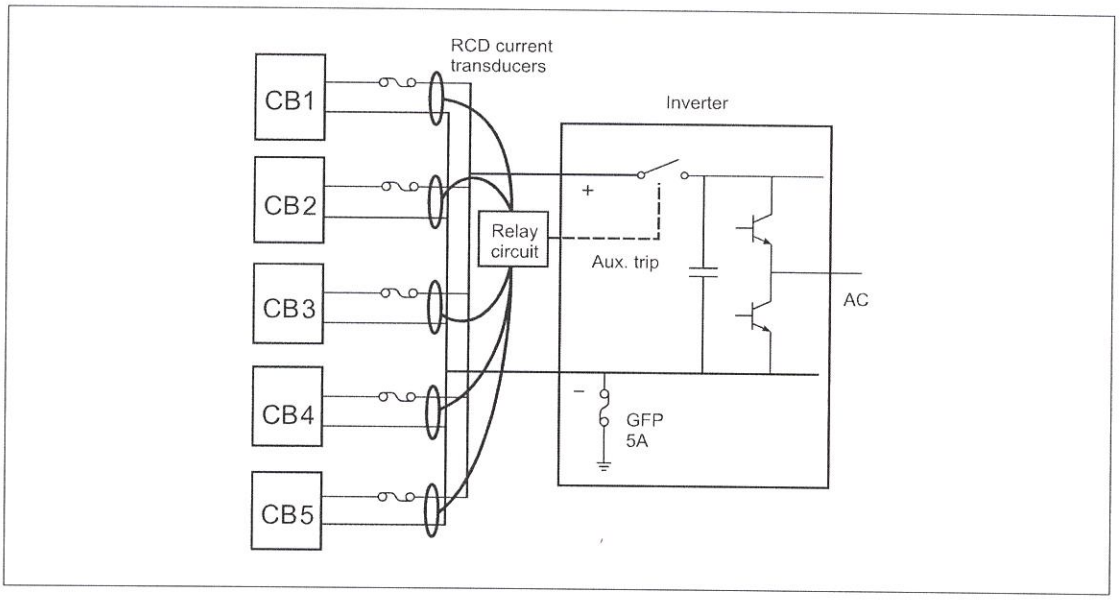


Fig. 3. Residual current measurements with auxiliary trip (CB = combiner box, RCD = residual current disconnect, GFDI = ground fault detection and interruption)

2.3.2.1 Provide ground fault detection systems with an alarm function for ungrounded systems.

2.3.3 Provide a remote DC disconnect for each combiner box as close as possible to the output side of the box for all new installations. See Figures 5 and 6.

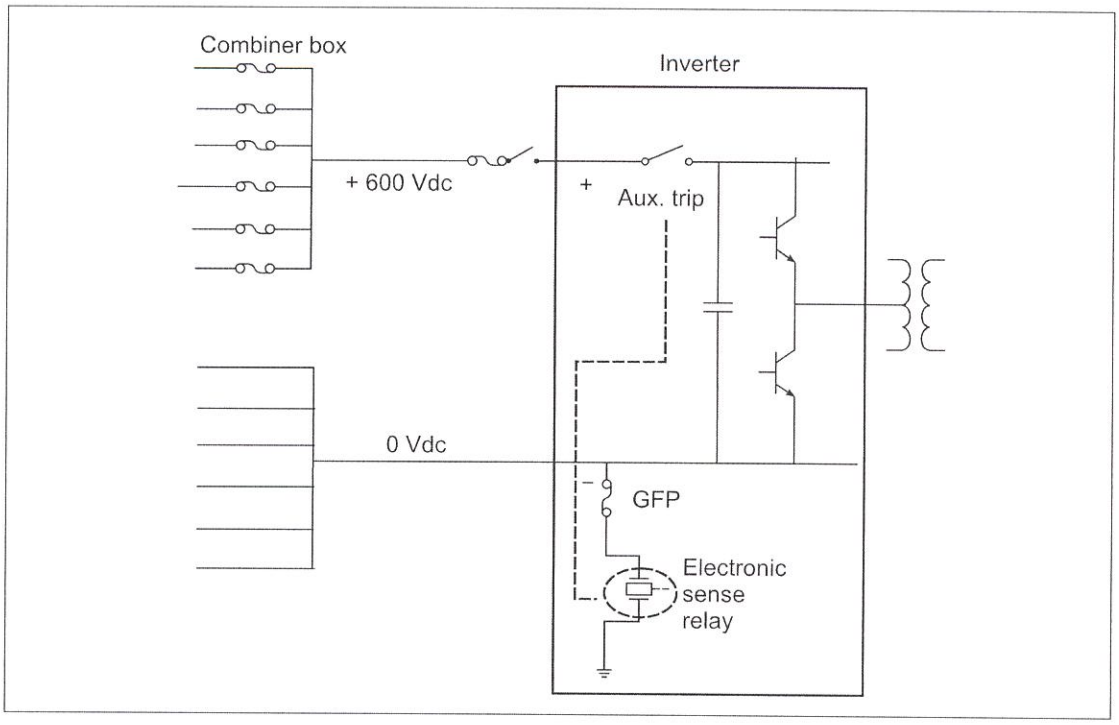


Fig. 4. Electronic current sensing relay in ground circuit

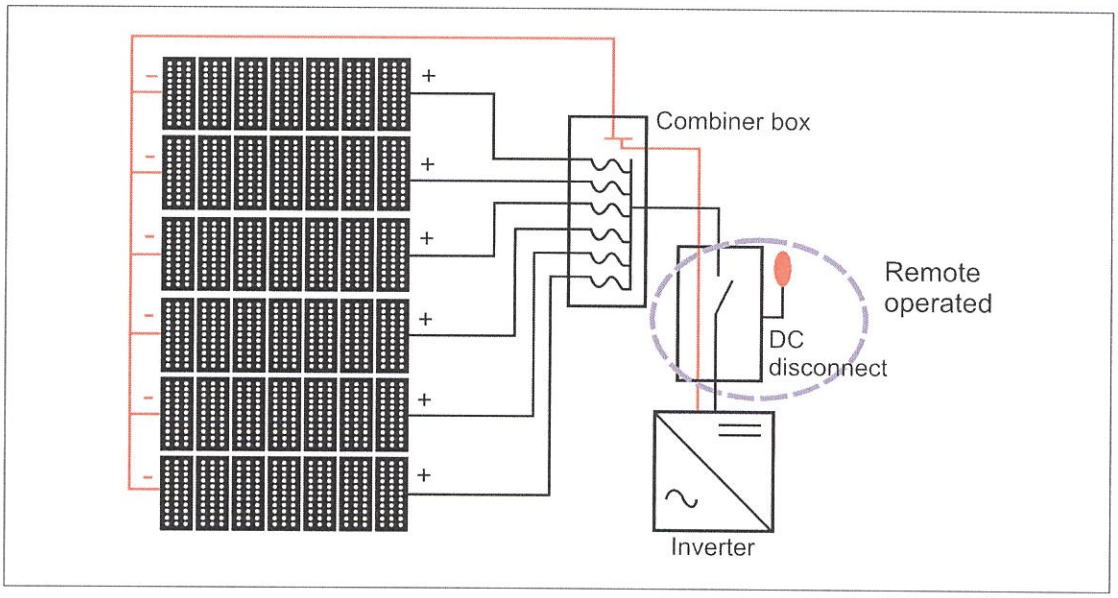


Fig. 5. One-line example diagram of remote-operated DC disconnect for grounded PV system (the negative pole is grounded at the inverter in this example)

2.3.4 Do not install electrical wiring within the rib opening of steel decking or otherwise within the plane of the above-deck components. Besides serving as a possible ignition source, it would also inhibit access for maintenance and repair and be subject to damage from mechanical fasteners used to secure above-deck roof components.

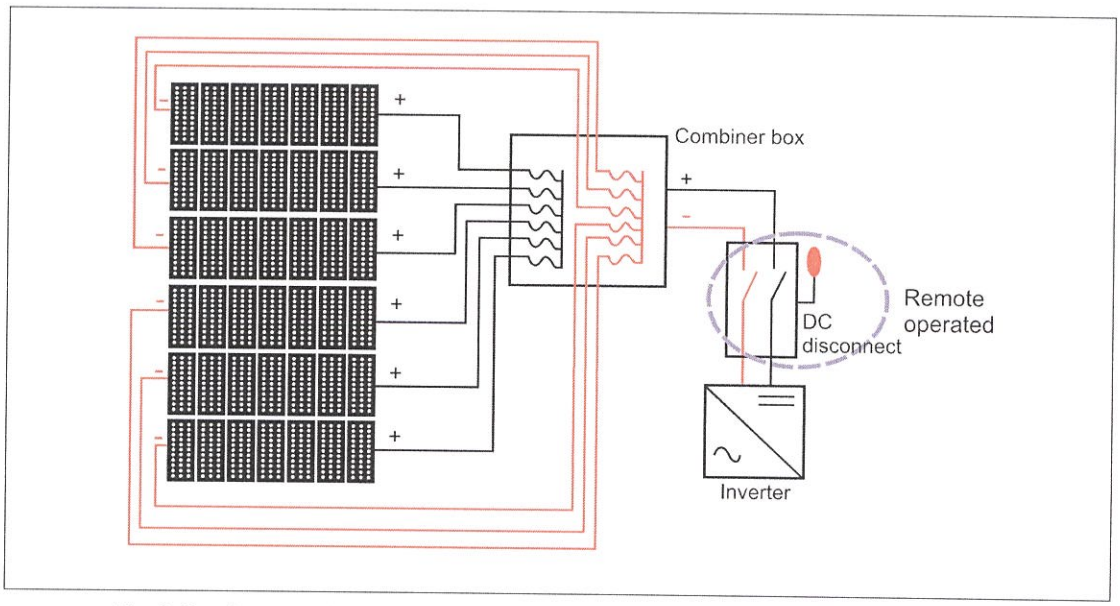


Fig. 6. One-line example diagram of remote-operated DC disconnect for ungrounded PV system

2.3.5 Ensure adequate provision is made for expansion and contraction due to extreme temperature fluctuations during the year. This includes wiring, as well as the interface between the PV panels and the roof cover.

2.3.6 Provide surge protection for the inverters on the DC and AC sides.

2.3.7 Provide reverse current overload fuses (RCOL) for each string of panels to prevent reverse current from undamaged parallel panel circuits being exerted on damaged panels.

2.3.8 Design and install cables and bus-bars in accordance with DS 5-31.

2.3.9 Use DC wires that are moisture and sunlight resistant and have a minimum temperature rating of 194°F (90°C).

2.3.10 Use rigid PV panels that meet electrical performance criteria per IEC/EN 61215, *Crystalline Silicon Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval.*

Use rigid PV panels that comply with criteria for electrical safety per IEC/EN 61730-2, Photovoltaic (PV) Module Safety Qualifications, Part 2: Requirements for Testing, or ANSI/UL 1703, *Flat Plate Photovoltaic Modules and Panels.*

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 Basic Operation of PV Systems

Rigid PV solar panels are made up of semiconductors in the form of individual silicon cells wired in series, and usually protected above by tempered glass and on the bottom by a polymeric encapsulant (back-sheet). Back-sheets are laminated in up to 3 layers and can consist of almost any combination of ethylene vinyl acetate (EVA), polyethylene terephthalate (PET), Kynar, or Tedlar. An anti-reflective coating is provided on the top surface. Modules are linked together in series to form strings, and then individual strings are connected within a combiner box to form an array. The modules within the array convert energy from sunlight into direct current (DC) electrical power. This power can be stored as DC, but more commonly it is converted to AC using an inverter, and then fed into a large electrical grid, or in some cases used directly on-site. Usually one or more arrays/combiner boxes are connected to an inverter when the electric power is converted from DC to AC.

Common sites for PV panels are roofs of warehouses and other facilities that do not require extensive rooftop equipment that would shadow the PV panels. Aisles are often provided within or between arrays to allow

access for maintenance of rooftop equipment and manual firefighting, as well as to prevent the panels being shadowed by other equipment, higher roofs, or other obstructions to sunlight. For additional information on rigid PV panels, see DS 7-106.

3.2 Wind Resistance

3.2.1 Boundary Layer Wind Tunnel (BLWT) Testing and Ballasted PV Systems

Testing in a boundary layer wind tunnel (BLWT) is conducted to determine wind loads and resistance for roof-mounted PV panels. It is important that the scaled models used to replicate the proposed roof-mounted panels be as representative as possible, particularly with ballasted arrays. This includes the sizes of individual panels, the weights of the panels and ballast, the PV panel slope (see Figure 8), the coefficient of friction (μ) between the roof surface and the underside of the panel pedestals or paver trays, and the size of the array. Tests should replicate the minimum array size to be used, with regard to the number of interconnected panels within a given array and the minimum number of panels within a row or column.

To allow the test data to be used for a variety of combinations of roof cover types and pedestal pads/paver trays, separate testing may be needed to quantify the coefficient of friction between the two surfaces. Testing should reflect any slip sheets that may be used. Since movement of any panel defines failure, the use of the static coefficient of friction may be used in lieu of the dynamic value. While often the wet coefficient of friction yields a lower value, test data reflects that in some cases the dry value is lower.

Testing needs to be conducted in a boundary layer wind tunnel (BLWT) rather than an aerospace wind tunnel (AWT). While there are some similarities between the two types, the BLWT simulates wind flow toward a building by providing obstructions between the entrance of the wind into the tunnel and the scaled building model. Typically, but not always, an open terrain or Exposure C is simulated. The simulated building is often a flat rigid object. This allows the wind to hit the wall of the model, flow over it, and create turbulence and vortices that cause higher uplift pressures above the roof, particularly at the perimeter and corner areas. Such a realistic effect is not provided when using an AWT. Even in a BLWT, internal building pressure effects and vertical movement of the roof cover are not simulated. Such movement of the roof cover can increase the drag and lift coefficients for the PV panels, and the presence of a mechanically fastened roof cover (MFRC, see Figure 7) can make the results of the BLWT invalid. This is not a concern with fully adhered roof covers. PV panels used over MFRC should be mechanically fastened.

While there are numerous AWTs, a limited number of BLWTs exist. The following locations have BLWTs:

- Colorado State University (CSU)
- Western University (formerly the University of Western Ontario or UWO), Ontario, Canada
- Cermak, Peterka and Peterson (CPP) in Colorado and Australia
- Rowan, Williams, Davies and Irwin, Inc. (RWDI), Canada
- I.F.I. Institute, Germany
- Force Technology, Europe
- University of California, Davis
- University of Maryland
- University of Minnesota
- Concordia University, Montreal, Quebec, Canada

A. Experimental wind load estimates on roof-mounted solar panels can be inaccurate for the following reasons:

1. The experiments were conducted without considering the effect of the building on the solar panels. This includes experiments that were conducted in an AWT, which is used for testing cars and aircraft. These types of wind tunnels produce smooth wind at a constant speed, and at very low turbulence intensity (< 0.5%). In order to study the wind load on roof-mounted solar panels, experiment have to be conducted in a BLWT, where the wind is turbulent and gusty with high turbulence intensity (>10%). The wind tunnel

experiments also have to be conducted in accordance with the ASCE's *Wind Tunnel Studies of Buildings and Other Structures*.

2. The experiments were conducted only for a single wind direction. Just like the roof itself, the tilted solar panels can experience substantial wind loads from cornering winds.

B. Wind load estimates obtained using only CFD simulations on roof-mounted solar panels are not recommended by ASCE and may be inaccurate for the following reasons:

1. The simulations were performed without considering the effect of the building on the solar panels.

2. Validation of the CFD simulations with existing literature or with BLWT experiments were not performed.

3.2.1.1 Increased Ballast Around Openings

Often there will be aisle spaces around other roof-mounted equipment that break the continuity of the interconnection between panels. This reduces the wind load distribution, as well as the shielding affect against wind that the outer panels in the array provide for those panels farther in from the edges. In order to account for this, additional ballast should be provided for the panels immediately around the openings.

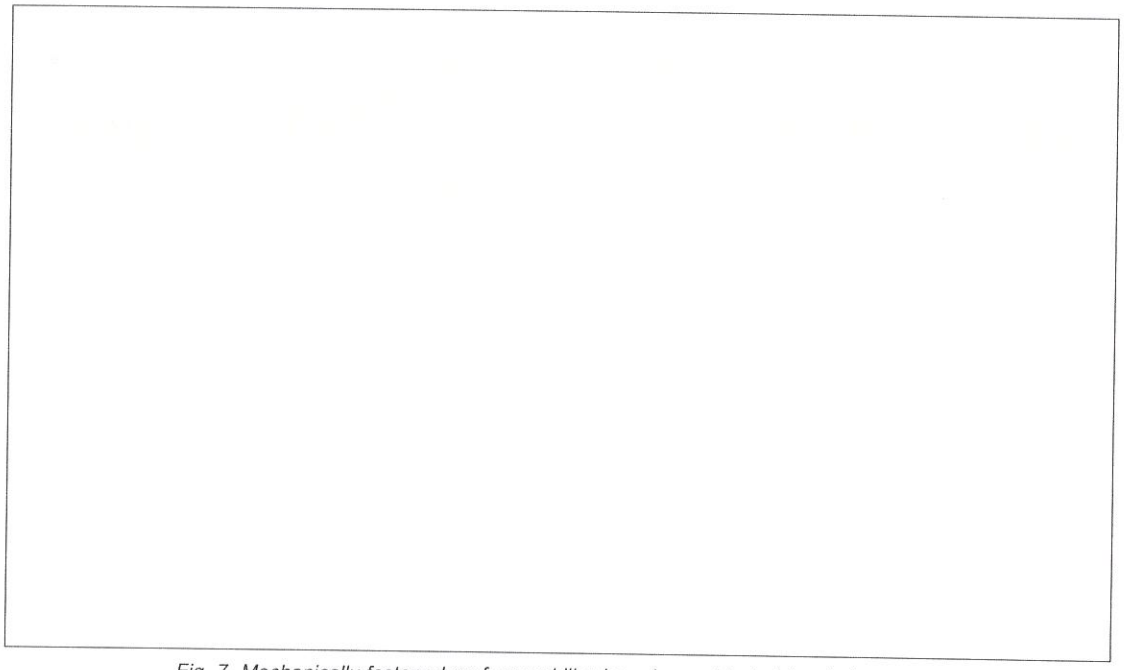


Fig. 7. Mechanically fastened roof cover billowing when subjected to wind pressure

Fig. 8. Solar panels with steeper slopes or lacking wind deflectors will experience greater wind effects

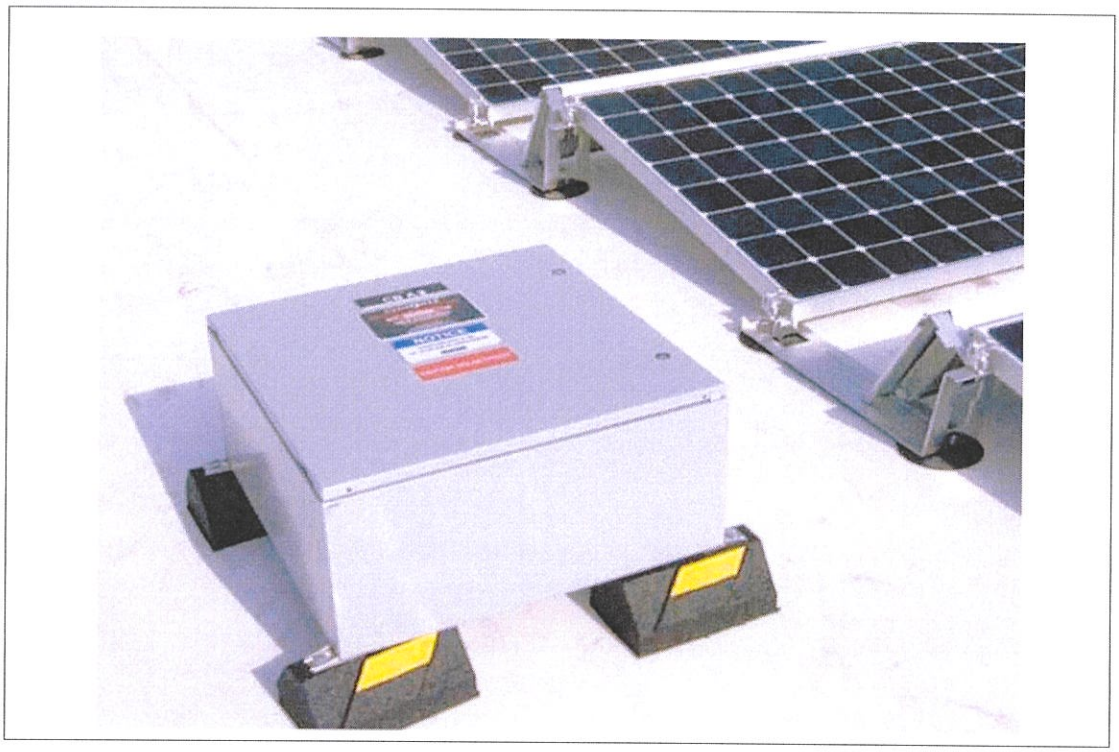


Fig. 9. Equipment lacking anchorage to roof framing

3.2.2 PV Systems Fastened to Standing Seam Roofs (SSR)

Rigid PV panels can be mechanically fastened to SSRs and can be FM Approved in accordance with Approval Standard 4478. For more information on SSRs, see DS 1-31. SSR panels are seamed to the internal clips, which are pre-fastened at each deck rib to each steel purlin or a continuous substrate. The wind design for SSR assumes the wind load is distributed evenly to each internal clip. An external seam clamp, similar to those used to enhance the wind resistance of SSRs, is used to connect PV panels to the SSR deck ribs (see Figures 10 and 11). These clamps do not penetrate the seam. One clamp should be provided at each standing seam rib at the down-slope and up-slope edges of the PV panels. The spacing between clamps may vary from about 3 to 10 ft^2 (0.3 to 1.0 m^2) per clamp, depending on the SSR rib spacing and the distance between internal clips along the deck seams. It is important that the individual clamp be designed to fit the specific seam of the SSR.

Fig. 10. Solar panels secured to standing seam roofs using external seam clamps

Fig. 11. Unacceptable arrangement: clamp missing from SSR rib below middle of outer panel edge

3.3 Fires and Electrical Ignition Sources

3.3.1 Ground Fault Protection

Numerous fires have started in U.S. installations of roof-mounted PV arrays due to inadequate ground fault protection. Such installations in the United States typically include conductors that are intentionally grounded, but have ground fault detection designed for ungrounded conductor faults. This design is based on conservative assumptions of leakage current to avoid nuisance trips. However, the present ground fault detection uses fuses that are not sensitive enough, resulting in undetected ground faults. Such systems have become more prevalent in recent years and, as they continue to age, the frequency of such fires could increase.

Fires of electrical origin are fairly common in roof-mounted solar arrays. There are sufficient combustibles present in the form of roof coverings and insulation, which are more likely to become ignited with the PV system there. Also, the redirection of flames and reradiation of heat by the PV panels from a roof fire tend to create more fire spread than if the panels were not there. Following the electrical guidance in this document will reduce, but not eliminate, the potential for a fire.

3.3.2 Preventing Fires from DC Ground Fault in PV Arrays

A ground fault in a PV array is an accidental electrical short circuit involving ground and one or more normally designated current-carrying conductors. Ground faults in PV arrays are safety concerns because they may generate DC arcs at the fault point on the ground fault path, damage surrounding insulation, and create fire hazards. The risk of fire is escalated substantially if a second ground fault is developed. A DC ground fault is common in PV systems and result from the following causes:

A. Insulation failure of cables (e.g., an animal chewing through cable insulation and causing a ground fault)

B. Incidental short-circuit between the normal conductor and ground (e.g., a cable in a PV junction box incidentally contacting a grounded conductor)

C. Ground faults within PV modules (e.g., a solar cell short-circuiting to grounded module frames due to deteriorating encapsulation, impact damage, or water corrosion in the PV panel

D. Abraded wire insulation caused during installation or from thermal movement of the components

To properly protect PV arrays from ground fault damage and ensuing fire, NFPA 70, National Electrical Code, Article 690.5(A), specifies that ground fault protection device (GFPD) or system must be capable of detecting a ground-fault current, interrupting the flow of fault current, and providing an indication of the fault. According to recent industry experience, there are some cases where the first ground fault could not be detected by the currently design GFPD (such as applying a fuse in the grounding electrode). A second ground fault made the fault current flow in the array, leading to fire. Figure 12 (A, B and C) illustrates the unnoticed first ground fault and the danger of a second ground fault in a PV system. Sophisticated techniques, such as residual current monitoring, to measure the imbalance of current flow in the positive and negative feeders from the inverter to each combiner box are being developed to improve ground fault protection.

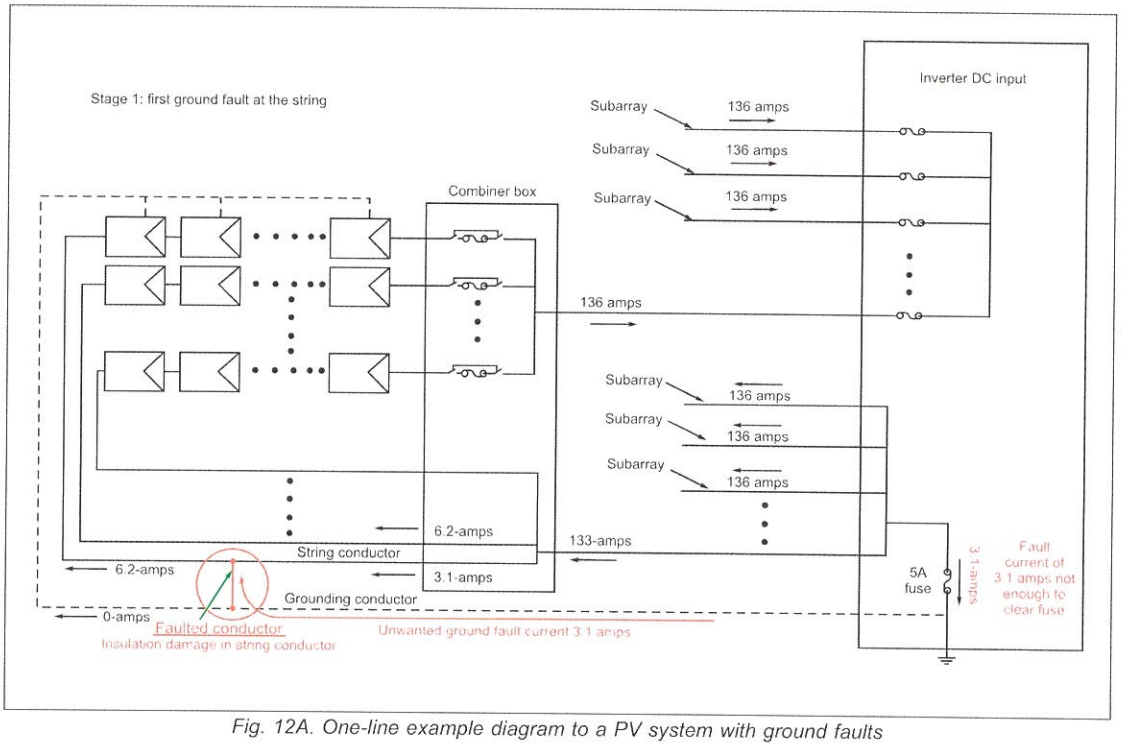


Fig. 12A. One-line example diagram to a PV system with ground faults

In Figure 12, note the following:

1. The PV system shown has eight combiner boxes with a normal DC output of about 136 A.
2. The DC string conductor as the input of the combiner box has a normal DC current of 6.2 A.
3. The first ground fault at the string conductor only generates about 3.1 A ground fault current, which is not sufficient to melt the fuse as the ground fault protection in this system (Part A)
4. When the 2nd ground fault develops at the array conductor, a return path is established (internal short circuit developed). The ground fault protection fuse operates (Part B), however, is no longer able to interrupt the fault current because of the internal return path established by these two ground faults. In the example shown, the string conductor, which normally carries 6.2 A current, has about 1082 A fault current. This high level of fault current can potentially cause a fire (Part C).

3.4 Exterior Fire Spread in Roof-Mounted PV Arrays

Where roof-mounted PV arrays are present, the risk of exterior fire spread is much greater than it would be for the roof assembly alone. This would be the case even if the solar panels had no combustible components. A typical fire scenario is the electrical wiring associated with the solar PV array causing ignition of the roof assembly. The potential flame height is largely a function of the type of roof cover and insulation immediately below the array. While the presence of solar panels may affect combustion air being drawn to the fire, it otherwise does not reduce, but redirects the flames from the roof fire.

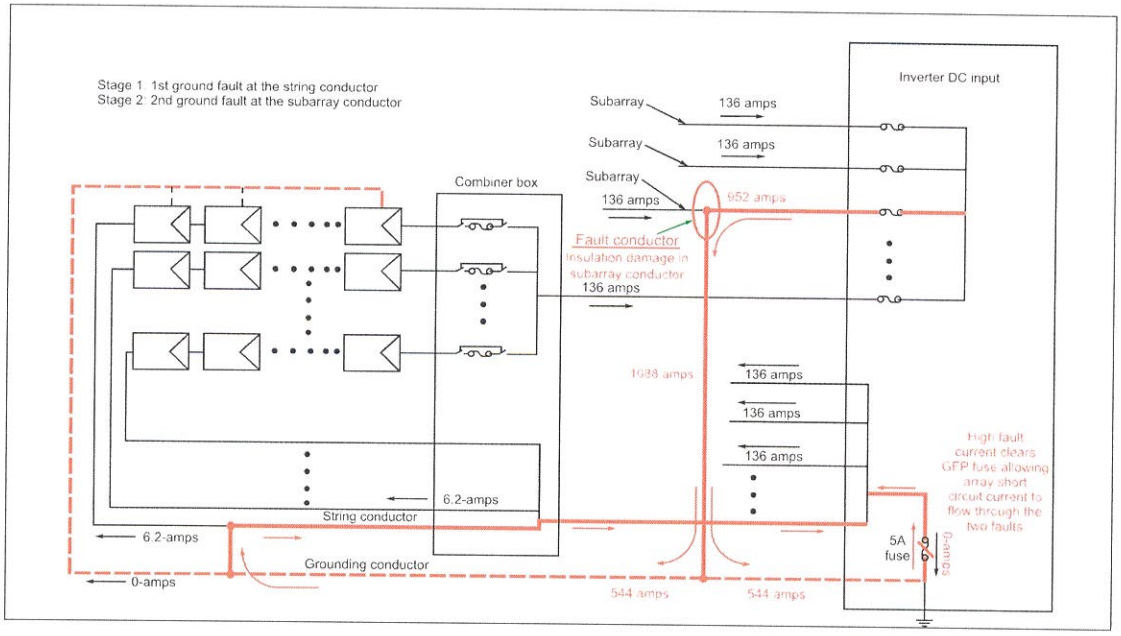


Fig. 12B. One-line example diagram to a PV system with ground faults

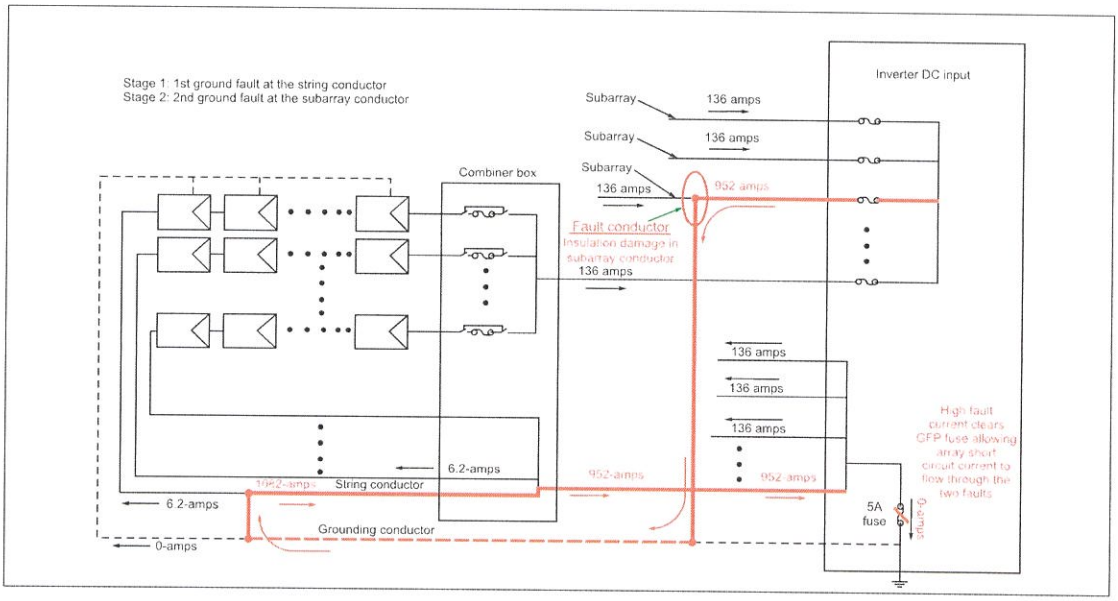


Fig. 12C. One-line example diagram to a PV system with ground faults

3.5 Gravity Loads and Roof Drainage

For systems that use curbs or continuous support beams, ensure these components do not adversely affect roof drainage (rain water weighs 5.2 psf per in. of depth, or 1 kg/m^2 per mm). Consider the design rainfall intensity on the roof, paths to the roof drains, how much water will have to flow through the curbs or beams, and whether the drainage holes or spaces are large enough to accommodate that flow. The height of the curb should be limited to act as a secondary drainage method from within the curbed area in case drain holes are clogged by leaves or debris. For additional information on roof drainage, see DS 1-54.

3.6 Hail Resistance

Hail resistance of rigid PV panels should be determined by ice ball testing in accordance with Approval Standard 4478. Hail resistance of flexible PV panels should be determined by steel ball testing in accordance with Approval Standard 4476.

Impact from hail larger than that for which the panels were successfully tested could cause severe damage to the PV panels.

3.7 Flexible PV Installations

Adhered, flexible solar panels are FM Approved in accordance with Approval Standard 4476, as specified in Roof*Nav* and are required to be adhered across their entire underside. Flexible solar panels that are only secured around their edges will not uniformly distribute the wind load to the roof cover they are adhered to.

4.0 REFERENCES

4.1 FM Global

Data Sheet 1-2, *Earthquakes*
Data Sheet 1-22, *Maximum Foreseeable Loss*
Data Sheet 1-28, *Wind Design*
Data Sheet 1-29, *Roof Deck Securement and Above-Deck Roof Components*
Data Sheet 1-31, *Metal Roof Systems*
Data Sheet 1-54, *Design Loads for New Construction*
Data Sheet 5-11, *Lightning Protection*
Data Sheet 5-19, *Switchgear and Circuit Breakers*
Data Sheet 5-20, *Electrical Testing*
Data Sheet 5-23, *Emergency and Standby Power Generating Systems*
Data Sheet 7-106, *Ground-Mounted Photovoltaic Solar Power*

FM 4476, *Approval Standard for Flexible Photovoltaic Modules*
FM 4478, *Approval Standard for Rigid Photovoltaic Modules*
ANSI/FM 4473, *Test Standard for Impact Testing of Rigid Roofing Material by Impact Testing with Freezer Ice Balls*
Approval Guide, Building Materials section, an online resource of FM Approvals
Roof*Nav*, an online resource of FM Approvals for roofing professionals

4.2 Other

American Society of Civil Engineers (ASCE). *Minimum Design Loads for Buildings and Other Structures.* ASCE 7.

American Society of Civil Engineers (ASCE). *Wind Tunnel Studies of Buildings and Other Structures. Manual of Practice 67.*

American Society of Civil Engineers (ASCE). *Wind Tunnel Testing for Buildings and Other Structures. ASCE 49.*

ASTM International. *Standard Specification for Concrete Roof Pavers.* ASTM C1491-11.

ASTM International. *Standard Test Method for Evaluating the Freeze-Thaw Durability of Dry-Cast Segmental Retaining Wall Units and Related Concrete Units.* ASTM C1262-10.

Underwriters Laboratories (UL). *Flat-Plate Photovoltaic Modules.* ANSI/UL 1703.

International Electrotechnical Commission (IEC). *Grid Connected Photovoltaic Systems: Minimum Requirements for System Documentation, Commissioning Tests and Inspection.* IEC 62446.

International Electrotechnical Commission (IEC). *Crystalline Silicon Terrestrial Photovoltaic (PV) Modules: Design Qualification and Type Approval.* IEC/EN 61215.

International Electrotechnical Commission (IEC). *Photovoltaic (PV) module safety qualifications, Part 2: Requirements for Testing.* IEC/EN 61730-2.

National Fire Protection Association (NFPA). *National Electric Code*. NFPA 70.

Structural Engineers Association of California (SEAOC). *Structural Seismic Requirements and Commentary for Rooftop Solar Photovoltaic Systems*. SEAOC PV1-2012.

Structural Engineers Association of California (SEAOC). *Wind Design for Low-Profile Solar Photovoltaic Arrays on Flat Roofs*. SEAOC PV2-2012.

4.3 Bibliography

ASTM International. *Fire Tests of Roof Coverings*. ASTM E108.

Grant, Casey C. *Fire Fighter Safety and Emergency Response for Solar Power Systems. Fire Protection Research Foundation (FPRF)*. May 2010 (revised October 2013).

International Standards Organization (ISO). *General Requirements for the Competence of Testing and Calibration Laboratories*. ISO/IEC 17025:2005.

Jackson, P. "Target Roof PV Fire of 4-5-09, 9100 Rosedale Hwy, Bakersfield, CA." City of Bakersfield, California, Development Services/Building Department Memorandum.

Los Angeles City Fire Department Requirement. *Solar Photovoltaic System*. FPB Requirement No. 96, 2-03-09.

Pagnamenta, R. "BP Solar Panel Blaze Raises Concerns Over Alternative Energy." The Times, Monday June 29, 2009.

APPENDIX A GLOSSARY OF TERMS

Aerospace wind tunnel: A wind tunnel that simulates horizontal wind forces acting directly on an object. It does not simulate conditions between the fans and the object within the lower portion of the boundary layer, which is required to replicate the surface roughness exposure related to wind design of the building and rooftop equipment. Neither does it replicate wind flow over a wall of a modeled structure below the rooftop equipment that would be required to simulate actual suction effects in addition to the horizontal forces.

Array size: The number of interconnected PV panels (the minimum number of panels within each row and each column) and the gross plan area occupied within a given array. There is usually a slight (fraction of an inch) separation between panels in the east-west direction and sufficient separation (depending on panel slope) between rows to prevent shadowing.Wind tunnel or field model tests should replicate the minimum array size required. Data for a larger array does not justify the design for a smaller array.

Ballasted: Not adhered to the roof cover below, nor fastened to the roof deck or structure. Resistance to wind loads is provided by the weight of the panels, mounting equipment, and any additional ballast. (Same as "loose laid.")

Boundary layer wind tunnel: A wind tunnel with a long transition between the fans and the object, and that has obstructions to replicate the lower portion of the boundary layer and the surface roughness exposure related to wind design of the building and rooftop equipment. Testing is done with scaled models of rooftop equipment and the building upon which it is installed.

Closed mounting system: A PV mounting system that has a wind deflector on the high side (north side in northern hemisphere and south side in southern hemisphere) of each row of panels, but may or may not have one on the east and west ends of each row.

Coefficient of friction (μ): A dimensionless coefficient used to quantify resistance to lateral movement (in this case, between the undersides of the panel mounts and the top surface of the roof cover). It is equal to the lateral load resistance divided by the force normal to the two mating surfaces. This will vary depending on the construction of the underside of the panel mount and the type of roof cover. Such construction includes, but is not limited to, stainless steel, aluminum, coated metal, or metal with a pad (such as a piece of single-ply roof cover material or rubber) adhered to its underside.

Computational fluid dynamics (CFD): A form of computer modeling that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows. Computers are used to perform the calculations required to simulate the interaction of fluids with surfaces defined by boundary conditions. Validation of such software is performed using a wind tunnel.

FM Approved: Products or services that have satisfied the criteria for Approval by FM Approvals. Refer to the *Approval Guide*, an online resource of FM Approvals, for a complete list of products and services that are FM Approved.

Hail day: A day in which minimum ¾ in. (19 mm) diameter hail occurred within 25 mi (40 km) of a location.

Inverter: An electrical device used to convert direct current (DC) electrical power to alternating current (AC) electrical power.

Loose Laid: not adhered to the roof cover below, nor fastened to the roof deck or structure. Resistance to wind loads is provided by the weight of the panels, mounting equipment, and any additional ballast. (Same as "ballasted.")

Moderate hail hazard area: Areas in the United States designated as such on the Hailstorm Hazard Map in DS 1-34, and areas outside the United States that have experienced, on average, fewer than three hail days per year.

Non-sheltered PV panels: PV panels located on the exterior side of an array in the perimeter row(s) of PV panels, and that are not sheltered from the wind load from other panels, and for which the wind load may be greater than that of the interior, sheltered panels.

Open mounting system: A PV-mounting system that does not have a wind deflector on the high side (north side in northern hemisphere and south side in southern hemisphere) of each row of panels.

Photovoltaic (PV) system: A system that uses solar panels to convert sunlight into electricity. It consists of PV panels, support framework, and electrical connections and equipment to allow regulating and converting the electrical output from DC to AC.

PV panel: An individual unit consisting of numerous cells, usually 60 or 72. It is usually about 39.4 in. (1 m) in the north-south direction and 65 to 77 in. (1.65 to 2.0 m) in the east-west direction. In most cases it is bounded by edge framing. In some cases panels are also reffered to as modules, particularly for ballasted situations. For anchored installations, three or four modules connected together may be considered a panel.

Roof control joint: A construction joint that provides a break in the continuity of above-deck roof components to prevent damage to the roof cover from thermal movement. This joint does not provide a break in the roof deck.

Roof expansion joint: A construction joint that provides a break in the continuity of the building framing, roof deck, and above-deck roof components to prevent damage to the building components from thermal movement.

Setback: The distance between the outside edge of a roof supporting solar panels and the outer edge of the solar array.

Severe hail hazard area: Areas in the United States designated as such on the Hailstorm Hazard Map in DS 1-34, and areas outside the United States that have experienced, on average, at least three hail days per year.

Shadowing: Shade created by neighboring objects that necessitate relocation of solar panels and sometimes openings within the array. This can create wind forces on solar panels immediately adjacent to the opening that are higher than the forces on the interior of the array.

Sheltered PV panels: PV panels located on the interior side of the perimeter row(s) of PV panels that are somewhat sheltered by the perimeter panels and for which the wind load is somewhat less than for the perimeter panels.

Very severe hail hazard areas: Areas in the United States designated as such on the Hailstorm Hazard Map in DS 1-34.

APPENDIX B DOCUMENT REVISION HISTORY

October 2014. Interim revision. Added additional diagram (Fig. 12B, *One-line example diagram to a PV system with ground faults*).

July 2014. This is the first publication of this document.

Indemnification and Insurance Exhibit
RFP Solar Photovoltaic Systems

For purpose of this Exhibit, the term "Contractor" shall also include their respective agents, representatives, employees, contractors of any tier; and the term "Town of West Hartford and West Hartford Board of Education" (hereinafter called the "Town") shall include their respective boards, commissions, officers, officials, employees, agents, representatives and volunteers.

I. INDEMNIFICATION

A. To the fullest extent permitted by law, the Contractor shall release, defend, indemnify, and hold harmless the Town of West Hartford, West Hartford Board of Education, and their respective boards, commissions, officers, officials, employees, agents, representatives and volunteers from any and all suits, claims, losses, damages, costs (including without limitation reasonable attorneys' fees), compensation, penalties, fines, liabilities or judgments of any name or nature for bodily injury, sickness, disease, or death; and/or damage to or destruction of real and/or personal property; and/or financial losses (including, without limitation, those caused by loss of use) sustained by any person or concern, including officers, employees, agents, contractors of any tier, or volunteers of the Town of West Hartford and West Hartford Board of Education, or the Contractor, or by the public, even if caused by the negligence of the Town, so long as the injury to person, property or financial losses is caused or alleged to have been caused in whole or in part by any and all negligent or intentional acts, errors or omissions of the Contractor, its officers, agents, contractors of any tier, or anyone directly or indirectly employed by them arising from or related to the performance of this Contract.

B. To the fullest extent permitted by law, the Contractor shall release, defend, indemnify, and hold harmless the Town of West Hartford, West Hartford Board of Education, and their respective boards, commissions, officers, officials, employees, agents, representatives and volunteers from any and all suits, claims, damages, costs, (including without limitation reasonable attorneys' fees), compensation, penalties, fines, liabilities or judgments that may arise out of the failure of the Contractor, its officers, agents, contractors of any tier, or anyone directly or indirectly employed by them to comply with any laws, statutes, ordinances, building codes, and rules and regulations of the United States of America, the State of Connecticut, the Town of West Hartford, or their respective agencies.

C. This duty to indemnity shall not be constrained or affected by the Contractor's insurance coverage or limits, or any other portion of the Contract relating to insurance requirements. It's agreed that the Contractor's responsibilities and obligations to indemnify shall survive the completion, expiration, suspension or termination of the Contract.

II. INSURANCE

A. Insurance Requirements

1. The Contractor shall obtain and maintain at its own cost and expense all the insurance described below continuously for the duration of the Contract, including any and all extensions, except as defined otherwise in this Exhibit.

2. Contractor's policies shall be written by insurance companies authorized to do business in the State of Connecticut, with a Best's rating of no less than A:VII, or otherwise approved by the Town.

3. All policies (with the exception of Worker's Compensation) shall be endorsed to include the Town of West Hartford, West Hartford Board of Education, and their respective boards, commissions, officers, officials, employees, agents, representatives, and volunteers as an Additional Insured. The coverage shall include, but not be limited to, investigation, defense, settlement, judgment or payment of any legal liability. Blanket Additional Insured Endorsements are acceptable. Any Insured vs. Insured language shall be amended to eliminate any conflicts or coverage restrictions between the respective Insureds.

4. When the Town or the Contractor is damaged by failure of the Contractor to purchase or maintain insurance required under this Exhibit, the Contractor shall bear all reasonable costs including, but not limited to, attorney's fees and costs of litigation properly attributable thereto.

B. **Required Insurance Coverages:**

1. **Commercial General Liability:** $2,000,000 each occurrence / $2,000,000 aggregate for premises/operations, products/ completed operations, contractual liability, independent contractors, personal injury and broad form property damage. Contractor shall continue to provide products/ completed operations coverage for two (2) years after final completion of the work.

2. **Automobile Liability and Physical Damage Coverage:** $1,000,000 each accident for any auto, including uninsured/underinsured motorist coverage and medical payments. Policy shall include collision and comprehensive physical damage coverage.

3. **Umbrella Liability:** $2,000,000 each occurrence / $4,000,000 aggregate, following form.

4. **Professional Liability (claims-made):** $2,000,000 each claim / $2,000,000 aggregate. Retroactive date under the policy shall precede the effective date of this Contract. The Contractor shall maintain continuous coverage or obtain an extended reporting period in which to report claims for three (3) years following the end of the Contract.

5. **Valuable Papers and Records Coverage.** $50,000 limit to reestablish, recreate or restore any and all records, papers, maps, statistics, survey notes and other data, if made unavailable by fire, theft, flood, or any other cause, regardless of the physical location of these insured items.

6. **Workers' Compensation and Employer's Liability:** Statutory coverage in compliance with the Workers' Compensation laws of the State of Connecticut. Policy shall include Employer's Liability with minimum limits of $1,000,000 each accident, $1,000,000 disease/policy limit, $1,000,000 disease/each employee.

   The Contractor represents that they are currently in compliance with all requirements of the State of Connecticut Workers' Compensation Act and that it shall remain in compliance for the duration of the Contract. The Contractor agrees that Workers' Compensation is their sole remedy and shall indemnify and hold harmless the Town from all suits, claims, and actions arising from personal injuries to the Contractor, however caused. This indemnity shall not be affected by a lapse of Workers' Compensation coverage and/or if the Contractor failed, neglected, refused or is unable to obtain Workers' Compensation insurance.

7. **Personal Property:** All personal property of the Contractor are the sole risk of the Contractor. The Contractor agrees to indemnify, defend and hold harmless the Town from any and all losses or damages, however caused, to any and all personal property belonging to the Contractor.

C. **Additional Terms**

1. Minimum Scope and Limits: The required insurance shall meet the minimum scope and limits of insurance specified in this Exhibit, or required by applicable federal, state and/or municipal law, regulation or requirement, whichever coverage is greater. Providing proof of compliance with the insurance requirements described in this Exhibit is not intended, and shall not be construed to exclude the Town from additional limits and coverage available to the Contractor.

   Acceptance by the Town of insurance submitted by the Contractor does not relieve or decrease in any manner the liability of the Contractor arising out of or in connection with this Contract. The Contractor is responsible for any losses, claims and costs of any kind which exceed the Contractor's limits of liability, or which may be outside the coverage scope of the policies, or a result of non-compliance with any laws including, but not limited to, environmental laws. The requirements herein are not intended, and shall not be construed to limit or eliminate the liability of the Contractor that arises from the Contract.

2. Certificates of Insurance: The Contractor shall provide certificates of insurance, policy endorsements, declaration page(s) or provisions acceptable to the Town confirming compliance with this Exhibit and thereafter upon renewal or replacement of each required policy of insurance. Upon request, the Contractor agrees to furnish complete copies of the required policies.

3. Subcontractors: Contractor shall cause all contractors of any tier, acting on its behalf, to comply with this Exhibit. The Contractor shall either include its contractors as an Insured under its insurance policies or furnish separate certificates of insurance and endorsements for each subcontractor.

4. Premiums, Deductibles and Other Liabilities: Any and all related costs, including but not limited to, deductibles, retentions, losses, claim expenses, premiums, taxes, and audit charges earned are the sole responsibility of the Contractor.

5. Occurrence Form, Primary and Non-Contributory: All required insurance coverage shall be written on an occurrence basis, except as defined otherwise in this Exhibit. Each required policy of insurance shall be primary and non-contributory with respect to any insurance or self-insurance maintained by the Town.

6. Claims-made Form: Insurance coverage written on a claims-made basis shall have a retroactive date that precedes the effective date of this Contract. The Contractor shall maintain continuous coverage or obtain an extended reporting period in which to report claims following end of the Contract, for a minimum of two (2) years, except as defined otherwise in this Exhibit.

7. Waiver of Rights of Recovery: Both the Contractor and Contractor's insurers shall waive their rights of recovery or subrogation against the Town.

8. Claim Reporting: Any failure of the Contractor to comply with the claim reporting provisions of the required insurance policies shall not relieve the Contractor of any liability or indemnification in favor of the Town for losses which otherwise would have been covered by said policies.

9. Cancellation Notice: Each required insurance policy shall not be suspended, voided, cancelled or reduced except after thirty (30) days prior written notice has been given to the Town, ten (10) days for non-payment of premium.

10. Compliance: Failure to comply with any of the indemnification or insurance requirements may be held a willful violation and basis for immediate termination of the Contract